CLAIMS

WHAT IS CLAIMED IS:

1. A method for solid free-form fabrication of a three-dimensional object, comprising:

depositing a bulk amount of phase-change material in a defined region;

selectively ink-jetting an ultraviolet initiator onto a predetermined area of said defined region, wherein said ultraviolet initiator defines a cross-sectional area of said three-dimensional object; and

exposing said ultraviolet initiator to an ultraviolet light to facilitate cross-linking of said defined region.

2. The method of claim 1, wherein the depositing a bulk amount of phase-change material step is performed after the selectively ink-jetting an ultraviolet initiator step.

3. The method of claim 1, wherein said depositing a bulk amount of phase-change material comprises depositing a pre-determined quantity of phase-change material with one of a print head operating in a low precision condition, a bulk spraying apparatus, a roller, a screen-printing device, or a doctor-blade device.

4. The method of claim 1, wherein said selectively ink-jetting an ultraviolet initiator comprises controllably jetting said ultraviolet initiator to predetermined locations of said defined region.

5. The method of claim 4, wherein said ultraviolet initiator is controllably jetted into a non-solid phase-change material.

6. The method of claim 4, wherein said ultraviolet initiator is controllably jetted on top of a solidified phase-change material.

7. The method of claim 6, wherein said ultraviolet light is configured to re-liquefy a surface layer of said phase-change material.

8. The method of claim 7, wherein said ultraviolet light further comprises infrared radiation.

9. The method of claim 4, wherein said ultraviolet initiator is controllably jetted by one of a thermally actuated inkjet dispenser, a mechanically actuated inkjet dispenser, an electrostatically actuated inkjet dispenser, a magnetically actuated inkjet dispenser, a piezoelectrically actuated inkjet dispenser, or a continuous inkjet dispenser.

10. The method of claim 1, wherein said ultraviolet light facilitates a selective cross-linking of said phase-change material.

11. The method of claim 10, wherein said ultraviolet light is provided by one of a scanning unit or a flood exposer.

12. The method of claim 10, further comprising removing a non-cross-linked phase-change material from said cross-linked phase-change material.

13. The method of claim 12, wherein said non-cross-linked phase-changed material is removed from said cross-linked phase-change material by the application of a thermal energy.

14. The method of claim 1, further comprising applying ultrasonic energy to said phase-change material;

wherein said ultrasonic energy is configured to facilitate a mixing of said phase-change material and said ultraviolet initiator.

15. The method of claim 1, wherein said phase-change material comprises one of an unsaturated monomer containing at least one unsaturated functionality or an oligomer containing at least one unsaturated functionality.

16. The method of claim 15, wherein a melting temperature of said phase-change material is higher than an ambient melting temperature.

17. The method of claim 16, wherein said phase-change material comprises one of a stearyl acrylate, a cyclohexane dimethanol dimethacrylate, a cyclohexane dimethanol diacrylate, or a tris (2- hydroxy ethyl) isocyanurate triacrylate.

18. The method of claim 15, wherein said phase-change material comprises a high melting unsaturated monomer or oligomer combined and plasticized with an unsaturated monomer or oligomer having a lower than ambient melting temperature.

19. The method of claim 18, wherein said unsaturated monomer or oligomer having a lower than ambient melting temperature comprises one of an isodecyl methacrylate, a 2-phenoxyethyl acrylate, an isobornyl acrylate, a propylene glycol monomethacrylate, a propylene glycol dimethacrylate, an ethylene glycol dimethacrylate, a 1,6-hexanediol dimethacrylate, a urethane acrylate, or an epoxy acrylate.

20. The method of claim 1, wherein said ultraviolet initiator comprises one of an aromatic ketone or a hydroxyl ketone.

21. The method of claim 20, wherein said ultraviolet initiator comprises one of a, benzyl dimethyl ketal, a benzoin n-butyl ether, a trimethyl benzophenone, a benzophenone, or an alpha hydroxy ketone.

22. The method of claim 1, wherein said phase-change material comprises a polymerizable epoxy functionality; and

said ultraviolet initiator comprises a jettable cationic photoinitiator.

23. The method of claim 22, wherein said jettable cationic photoinitiator comprises a solution of one of a triaryl sulfonium hexafluoroantimonate, a triaryl sulfonium hexafluorophosphate, or diaryl iodonium hexafluorophosphate.

24. The method of claim 1, wherein said ultraviolet initiator comprises a photoinitiator synergist.

25. The method of claim 1, wherein said ultraviolet initiator comprises one of a dye or a colorant.

26. The method of claim 1, wherein said ultraviolet initiator is deposited prior to said depositing of a bulk amount of phase-change material.

27. The method of claim 1, wherein said phase change material comprises one of a solid or a liquid when deposited.

28. The method of claim 26, wherein said phase change material is a solid when deposited.

29. The method of claim 28, wherein said solid phase change material is a powder or a sheet.

30. The method of claim 29, further comprising heating the solid phase change material to a liquid form either before or after the step of ink-jetting the ultraviolet initiator.

31. A system for solid free-form fabrication of a three-dimensional object comprising:

a phase-change build material including one of an unsaturated monomer containing at least one unsaturated functionality or an oligomer containing at least one unsaturated functionality; and

a jettable ultraviolet initiator;

wherein said jettable ultraviolet initiator is configured to facilitate a selective cross-linking of said phase-change build material upon an application of ultraviolet light.

32. The system of claim 31, wherein a melting temperature of said phase-change build material is higher than an ambient melting temperature.

33. The system of claim 32, wherein said phase-change build material comprises one of a stearyl acrylate, a cyclohexane dimethanol dimethacrylate, a cyclohexane dimethanol diacrylate, or a tris (2- hydroxy ethyl) isocyanurate triacrylate.

34. The system of claim 31, wherein said phase-change material comprises a high melting unsaturated monomer or oligomer combined and plasticized with an unsaturated monomer or oligomer having a lower than ambient melting temperature.

35. The system of claim 34, wherein said unsaturated monomer or oligomer having a lower than ambient melting temperature comprises one of an isodecyl methacrylate, a 2-phenoxyethyl acrylate, an isobornyl acrylate, a propylene glycol monomethacrylate, a propylene glycol dimethacrylate, an ethylene glycol dimethacrylate, a 1,6-hexanediol dimethacrylate, a urethane acrylate, or an epoxy acrylate.

36. The system of claim 31, wherein said ultraviolet initiator comprises one of an aromatic ketone or a hydroxyl ketone.

37. The system of claim 36, wherein said ultraviolet initiator comprises one of a, benzyl dimethyl ketal, a benzoin n-butyl ether, a trimethyl benzophenone, a benzophenone, or an alpha hydroxy ketone.

38. The system of claim 31, wherein said phase-change material comprises a polymerizable epoxy functionality; and

said ultraviolet initiator comprises a jettable cationic photoinitiator.

39. The system of claim 38, wherein said jettable cationic photoinitiator comprises a solution of one of a triaryl sulfonium hexafluoroantimonate, a triaryl sulfonium hexafluorophosphate, or diaryl iodonium hexafluorophosphate.

40. The system of claim 31, wherein said ultraviolet initiator comprises a photoinitiator synergist.

41. The system of claim 31, wherein said ultraviolet initiator comprises one of a dye or a colorant.

42. The system of claim 31, further comprising a phase-change build material dispenser configured to rapidly dispense a bulk quantity of said phase-change build material.

43. The system of claim 42, wherein said phase-change build material dispenser comprises one of a print head operating in a low precision condition, a bulk spraying apparatus, a roller, a screen-printing device, or a doctor-blade device.

44. The system of claim 42, further comprising a precision dispenser configured to selectively dispense said ultraviolet initiator.

45. The system of claim 44, wherein said precision dispenser comprises one of a thermally actuated inkjet dispenser, a mechanically actuated inkjet dispenser, an electrostatically actuated inkjet dispenser, a magnetically actuated inkjet dispenser, a piezoelectrically actuated inkjet dispenser, or a continuous inkjet dispenser.

46. The system of claim 44, further comprising an ultraviolet applicator.

47. The system of claim 46, wherein said ultraviolet applicator comprises one of a flood exposer or a scanning unit.

48. The system of claim 46, wherein said ultraviolet applicator is configured to melt a surface layer of a solidified quantity of said phase-change build material.

49. The system of claim 48, wherein said ultraviolet applicator is configured to selectively provide ultraviolet light and infrared radiation.

50. The system of claim 46, further comprising a computing device communicatively coupled to said phase-change material dispenser, said precision dispenser, and said ultraviolet applicator;

wherein said computing device is configured to control a fabrication of said three-dimensional object.

51. The system of claim 50 further comprising a thermal applicator configured to supply sufficient thermal energy to separate a non-cross-linked phase-change material from a cross-linked phase-change material.

52. A three-dimensional prototype composition, comprising:

multiple layers of cross-linked phase-change material in contact with one another;

wherein said multiple layers of cross-linked phase-change material were linked by a jettable ultraviolet initiator.

53. The composition of claim 52, wherein said cross-linked phase-change material comprises one of an unsaturated monomer containing at least one unsaturated functionality or an oligomer containing at least one unsaturated functionality, and a jettable ultraviolet initiator.

54. The composition of claim 53, wherein said phase-change material comprises one of a stearyl acrylate, a cyclohexane dimethanol dimethacrylate, a cyclohexane dimethanol diacrylate, or a tris (2- hydroxy ethyl) isocyanurate triacrylate.

55. The composition of claim 54, wherein said phase-change material comprises a high melting unsaturated monomer or oligomer combined and plasticized with an unsaturated monomer or oligomer having a lower than ambient melting temperature.

56. The composition of claim 55, wherein said unsaturated monomer or oligomer having a lower than ambient melting temperature comprises one of an isodecyl methacrylate, a 2-phenoxyethyl acrylate, an isobornyl acrylate, a propylene glycol monomethacrylate, a propylene glycol dimethacrylate, an ethylene glycol dimethacrylate, a 1,6-hexanediol dimethacrylate, a urethane acrylate, or an epoxy acrylate.

57. The composition of claim 52, wherein said ultraviolet initiator comprises one of an aromatic ketone or a hydroxyl ketone.

58. The composition of claim 57, wherein said ultraviolet initiator comprises one of a, benzyl dimethyl ketal, a benzoin n-butyl ether, a trimethyl benzophenone, a benzophenone, or an alpha hydroxy ketone.

59. The composition of claim 52, wherein said phase-change material comprises a polymerizable epoxy functionality; and

said ultraviolet initiator comprises a jettable cationic photoinitiator.

60. The composition of claim 52, wherein said ultraviolet initiator comprises a photoinitiator synergist.

61. The composition of claim 52, wherein said ultraviolet initiator comprises one of a dye or a colorant.

62. A system for solid free-form fabrication of three-dimensional objects comprising:

a phase-change build material including one of an unsaturated monomer containing at least one unsaturated functionality or an oligomer containing at least one unsaturated functionality; and

a jettable means for crosslinking said phase-change build material;

wherein said jettable means for cross-linking is configured to facilitate a selective cross-linking of said phase-change build material.

63. The system of claim 62, wherein said means for cross-linking comprises a jettable ultraviolet initiator.

64. The system of claim 62, further comprising a means for dispensing bulk quantities of said phase-change build material.

65. The system of claim 64, further comprising a means for precisely dispensing a quantity of said means for cross-linking said phase-change build material into said phase-change build material.

66. The system of claim 65, further comprising a means for applying radiation to said means for cross-linking.

67. The system of claim 66, further comprising a means for computing communicatively coupled to said system, wherein said means for computing is configured to control an operation of said system.